

Low-Temperature Aqueous Alteration on Mars and the Potential for Life

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We have explored the chemical weathering at low temperatures (as low as 0°C) in aqueous environments on Mars based on the increasing evidence for non-hydrothermal water at or near the martian surface. We examine the geochemical energy available from the interaction of martian surface or near surface materials with low temperature water. We calculate Gibbs free energy for 13 different weathering reactions. The aqueous weathering of 1 kg of an ultramafic rock like Chassigny meteorite at present martian conditions can support the construction of ~30 grams of microbes. The aqueous weathering of 1 kg of a basaltic rock on Mars can support the construction of ~ 26 grams of biomass at present martian conditions and ~32 grams for conditions likely in the past. This means that $\sim 1.3 \times 10^{19}$ grams of potential biomass could have been supported from weathering a global layer of rock 1 m thick. Our results show that chemical weathering of minerals at low temperatures (as low as 0°C) in aqueous environments on Mars can produce enough geochemical energy to support the construction of potential martian organisms.